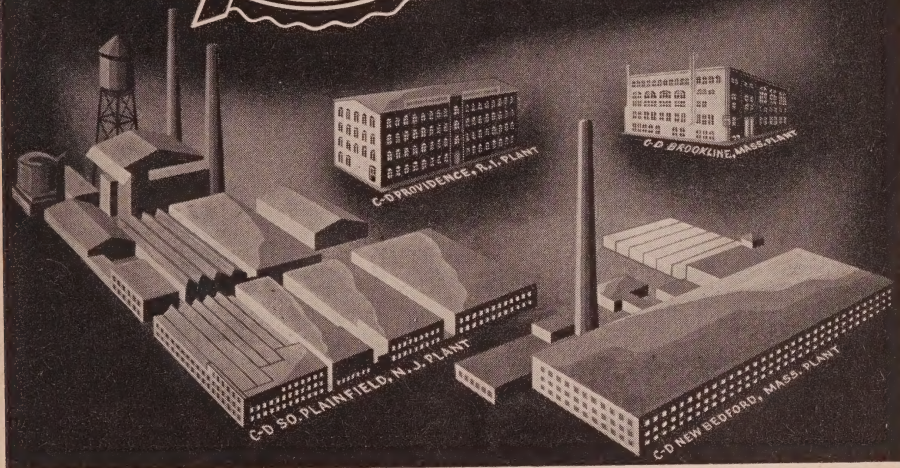


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VISUAL ALIGNMENT of TELEVISION RECEIVERS

The use of a sweep signal generator and oscilloscope for aligning television receivers is recommended by the service departments of many TV manufacturers.

The present state of the art of television transmission and reception requires that adjustments on such equipment be carried out with great care and understanding of the circuits involved, if optimum performance is to be achieved. The importance of visual alignment in the production, servicing, and development of television receivers is realized by all those familiar with or working in this new field. Technique of aligning a television receiver with the aid of a sweep signal generator differs somewhat from methods used on ordinary broadcast or communications receivers, but with proper equipment the procedure is quite simple and perhaps a lot more exacting.

To align the receiver by visual means, the service bench or laboratory must contain a sweep signal generator, oscilloscope, and the usual conventional test equipment. There are several sweep generators commercially available and they are quite similar in operation but differ somewhat in circuit design. The sweep signal generator is basically a frequency-modulated signal source, with means provided for variation of the sweep width, the average operating frequency, and as in the ordinary signal generator, the output signal amplitude. Before discussing the details of visual alignment, it would be well to review some facts about present day television receiver practice. There are two important i.f. frequency bands in use at the present time, one 8-13 mc. which was adopted before the war, and the other 21.25-26.5 mc. The latter is now accepted as standard for television broadcast receivers and will probably supersede the old i.f. band entirely.

The few television broadcast stations presently in operation utilize channel allocations below 88 mc. (44-88 mc.), however, in the near future, as these channels become filled, it will be necessary to provide test equipment for use on the higher frequency bands.

Bandwidth requirements for the i.f. amplifier vary with the type of receiver in use, particularly with the size of the picture tube. In some smaller picture tubes, 5" or 7", picture definition may be limited by the size of the scanning "spot" and thus a bandwidth of 2.5 to 3.5 mc. will suffice. However, the larger tubes, particularly those of later design, produce an exceedingly fine luminous spot. Here the maximum definition of the system may be realized and i.f. stages are adjusted for 3.75 to 4.25 mc. widths. The "front end" circuits of the conventional receiver require that the whole channel be amplified instead of just the video signal as in the picture i.f. amplifier. Since the picture and sound carriers are situated on opposite ends of the channel, 4.5 mc. apart, then the r.f. and mixer circuits must be tuned to operate over a range of about 5 mc.

Location of the video and picture carriers with respect to the receiver selectivity curve is another very important adjustment. This is another way of saying that the response curve of the receiver must not only be of proper bandwidth to accept the television signal, but must also be shaped accurately. The reason for this, illustrated in Fig. 1, is that transmission of the television signal is accomplished by the vestigial sideband system. In order to reproduce the lower frequencies (those sidebands near the carrier

* By M. H. Kronenberg in "Radio News."

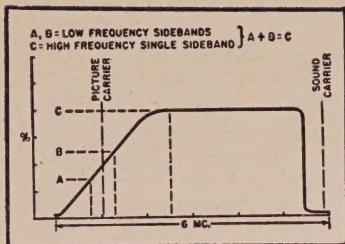


Fig. 1. Idealized video i.f. response curve showing operation of standard method of vestigial sideband television transmission.

frequency) faithfully, the characteristic of the receiver must be such that it allows these components to add up to a value that is equal in amplitude to the single sideband frequencies situated further away from the carrier (high frequency components). This is accomplished by designing the i.f. circuits so that with proper alignment, a sloping amplitude vs. frequency curve exists at the edge of the high frequency side of the i.f. band-pass, whereby the picture carrier frequency (reduced to i.f.) is situated where the response falls to about 50% of the mid-band value. At the same time the picture i.f. amplifier must reject the sound carrier, and traps provided for this purpose must be tuned exactly 4.5 mc. lower than the picture carrier frequency.

From this the importance of visual alignment may be realized and equipment requirements be evaluated. The sweep generator for use in television receiver alignment must be capable of producing a calibrated frequency modulated signal capable of operation in the frequency bands mentioned and also capable of generating sweep widths considerably greater than actual amplifier requirements. The oscilloscope used in conjunction with the sweep generator may be of the 3" variety. However, more satisfactory operation is obtained by using a 5" cathode-ray tube. Since the sweep generator generally supplies both horizontal and vertical deflection voltages, it is only necessary to provide a cath-

ode-ray tube with suitable power supply in order to obtain the visual alignment trace.

The Sweep Generator

The several sweep generators currently on the market for use in television work are capable of generating widths of from 100 kc. to 20 mc. and to operate at frequencies within the video, i.f. and r.f. bands. The sweep generator contains a wobulated or FM signal source, amplifier, and output attenuator. Some units also contain calibrated wavetraps for frequency marking of the visual trace. The cathode-ray tube that produces the alignment trace is usually incorporated in an oscilloscope as a separate piece of equipment. Present day sweep generators differ mainly in their method of frequency modulation. Narrow-band FM signal generators utilize the reactance tube and thus are purely electronic in operation, however, in wide-band sweep generators where sweep widths of 10 or 20 mc. are required, mechanical modulating systems are sometimes used. Some pre-war sweep generators used a motor-driven rotating capacitor as the frequency modulating element. Present day sweep generators use either a reactance tube modulated oscillator or a vibrating slug actuated by a magnetic drive similar to that used in loudspeakers. Since the signal generator must operate over such a broad frequency range, and also because of the broad sweep width requirements, it has been found desirable to incorporate a heterodyne oscillator system, whereby the output of two high frequency oscillators is mixed and their difference frequency selected to produce the desired lower frequency out-

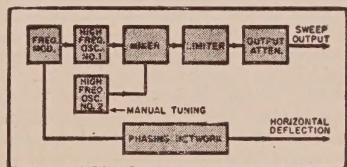


Fig. 2. Block diagram shows typical method used for obtaining the sweep signal.

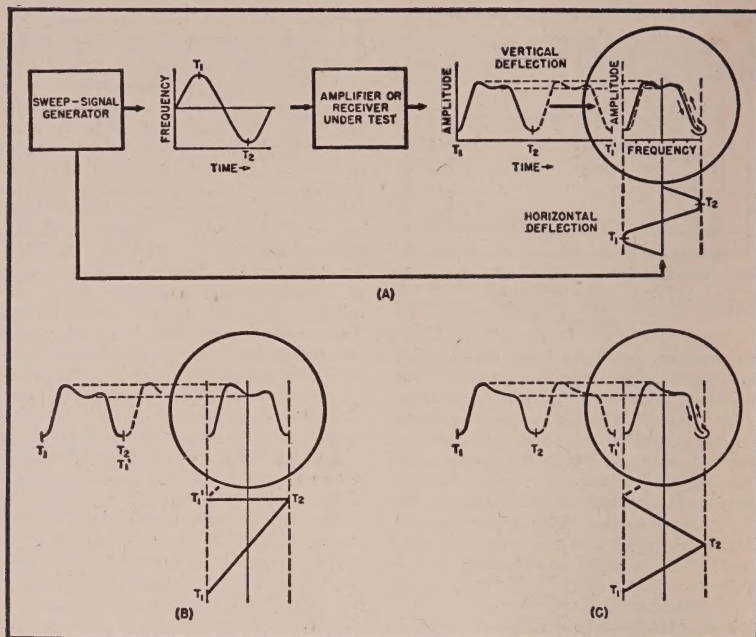


Fig. 3. Visual alignment wave shapes formed by sinusoidal sweep (A), saw-tooth sweep (B), and triangular sweep (C).

put. A block diagram showing a typical method for obtaining the sweep signal is given in Fig. 2. One of the oscillators is frequency modulated either electronically or mechanically and its mean or average frequency kept constant. The other oscillator is not modulated but is manually tuned so that the desired difference frequency appears in the mixer load circuit. The resultant or difference frequency thus obtained contains the desired sweep width and can be adjusted to sweep through the required frequency range by varying the sweep mechanism amplitude.

The sweep generator output is applied to the amplifier or receiver under test and the output of this amplifier is rectified and fed to the vertical deflection plates of an oscilloscope. At the same time the sweep generator must supply a horizontal deflection

voltage in order to produce a composite trace on the cathode-ray tube screen. This horizontal voltage is usually derived from the same source as that used to actuate the sweep mechanism. Therefore, the trace as it appears on the screen consists of a voltage fluctuating in accordance with the amplifier's response over a wide band of frequencies, plotted against a horizontal time base. The horizontal scale indicates frequency and the vertical scale, amplitude response within the band of frequencies under investigation. The most important relationship between horizontal and vertical deflection voltages is that they be exactly in phase and of the same frequency or in some definite harmonic relation. The way in which the composite trace is formed is shown in Fig. 3A, which indicates the result of a sweep generator whose output volt-

age, frequency modulated sinusoidally, is fed through a broad-band amplifier, and plotted against a sinusoidal time base of equal frequency.

In order to obtain a substantially linear frequency scale on the visual trace, it is necessary to use like waveforms in the sweep mechanism and horizontal sweep. This condition is satisfied in Fig. 3A although some variation in intensity of the trace will result due to the fact that the cathode-ray tube spot velocity varies from "slow" at the edges to "fast" at the center, and the edges of the trace will appear quite bright. While the sinusoidal sweep is perhaps the most convenient method of generating a visual alignment trace, other waveforms have been successfully used such as the saw-tooth and pyramid or triangular sweeps. Generators utilizing triangular or saw-tooth waveforms are useful mainly in electronic type sweep mechanisms. In mechanical systems it is more convenient to use a sinusoidal sweep.

Behavior of Over-coupled Circuits

The conventional television receiver contains 3 or 4 stages of i.f. amplification and usually a stage of r.f. ahead of the mixer. This means that adjustments must be made on at least 5 or 6 separate broad-band coupled circuits. Before proceeding, it is important not only to know the end result required, but also something of the behavior of the circuits involved.

One of the most common and effective methods of obtaining broad amplifier selectivity in r.f. and i.f. circuits is to employ the conventional double tuned over-coupled transformer. The coupling coefficient commonly used in video, r.f. and i.f. transformers is adjusted so that the amplitude vs. frequency characteristic just begins to show a double peaked response. Since the television receiver consists of many such transformers, each stage must be adjusted in such a way that the over-all response characteristic, which is a product of all individual stage responses, approximates as closely as possible the ideal curve.

Standard practice requires that the video carrier frequency be down 6 db. or 50% of mid-band amplification and that video response to the accompanying sound carrier be in the order of minus 40 db. (voltage) or more. In practice, peaks and troughs in the selectivity curve will result. It is usually considered satisfactory to adjust the over-all response curve so that the troughs, or minimum response points within the bandpass are never less than about 70% of peak values.

Extreme peaks may be caused by regeneration or undesired oscillations in the receiver under test, however, in commercial units or completed designs, they are most likely due to improper alignment. To illustrate how improper tuning may cause an improper selectivity curve, let us observe

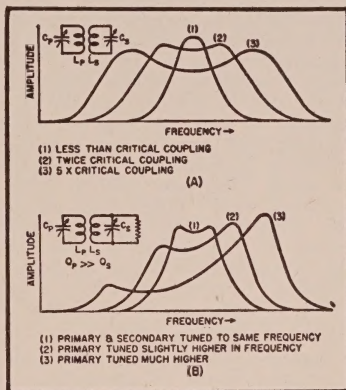


Fig. 4. Wave forms obtained by varying the coefficient of coupling (A) and the effects of mistuning on bandpass circuit (B).

some fundamental facts about over-coupled, double-tuned coupling. Fig. 4 shows how the conventional double-tuned r.f. transformer is affected by various conditions of coupling and tuning. Curves 1, 2, 3, of Fig. 4 indicate the effect of varying coefficient of coupling between the coils. As the coupling is increased beyond a critical point, the well known double peaked curve appears, and, assuming that L_p , C_p and L_s , C_s are tuned to the same

frequency, the peaks will be almost equal in amplitude and quite symmetrical. In the usual designs, television circuit couplings are adjusted so that they exhibit the double peaked characteristic to varying degrees. Unfortunately, in the over-coupled circuit, particularly where heavy damping is used, it is difficult to obtain the correct response characteristic so important in the television receiver, unless tuning is done carefully and with a knowledge of the behavior of the circuits being aligned. Fig. 4B shows effects of improper tuning of the transformer. In this case, where the secondary is heavily loaded, the stronger peaks will follow the tuning of the primary, or in other words, if the resonant frequency of $L_p C_p$ is lower than $L_s C_s$ then the stronger peak will be the lower frequency peak. Conversely, if $L_p C_p$ is tuned higher in frequency than $L_s C_s$, the stronger peak will be on the high frequency end of the bandpass. The effect of mistuning will be determined by the type of loading, and the usual methods of damping may be either damping both primary and secondary equally or loading down the secondary coil alone. The latter method is most commonly used. Where both primary and secondary are loaded equally, (equal Q 's) the effect of asymmetry due to mistuning will not be as pronounced. Note that the effect of mistuning is similar to increasing the coefficient of coupling between the coils.

Improper tuning may result in non-symmetrical peaks of unusually wide separation. If an amplifier, designed for reasonably flat response over a given bandwidth exhibits widely separated peaks with a deep trough in the center, one may suspect that the transformers are badly mistuned. The effect of mistuning is that the effective coefficient of coupling is increased in proportion to the degree of mistuning. The family of curves in Fig. 4B shows the effect on the frequency vs. amplitude response curve of a double-tuned transformer as the primary and secondary circuits are tuned correctly (curve 1) then tuning the primary to a higher frequency, (curves 2, 3), etc.

In this case, the damping resistor or load is mainly on the secondary coil. Note how the asymmetry and width of the curve increases as the mistuning is increased. The effect shown in Fig. 4B is very useful in providing information as to the degree of mistuning in the particular circuit under test. The experimenter can tell by observing the selectivity curve, just in what direction adjustments shall be made.

Alignment of a Typical Television Receiver

The most important section of the television receiver as far as determination of its selectivity or bandpass characteristic is the i.f. amplifier. The quickest and most accurate way of aligning its many tuned circuits is by visual means. The procedure, although in many ways similar to methods used in aligning a broadcast or communication receiver, requires, if the job is to be done properly, an oscilloscope, a wide-band FM or sweep generator, and a calibrated wavemeter or an ordinary signal generator. The latter equipment is used as a frequency marker, which will be found necessary if quantitative measurements are to be made directly on the cathode-ray tube screen. This so-called marker may be provided as part of the sweep generator or may have to be supplied as auxiliary equipment. Its function is to superimpose on the visual alignment trace a small "pip" or notch which indicates the frequency at any point on the curve. The visual alignment curve is merely an electronically drawn graph, with a marker to indicate the frequency at any point along its horizontal axis. Amplitude or gain measurements on the graph may be made directly.

The setup for alignment of the television receiver is indicated in Fig. 5. The sweep generator is first connected to the last i.f. grid and its output and frequency adjusted so that the uneven trace appears on the scope. Observation of the first trace will indicate the necessary adjustments to be made. A thorough understanding of the behavior of the circuits involved is use-

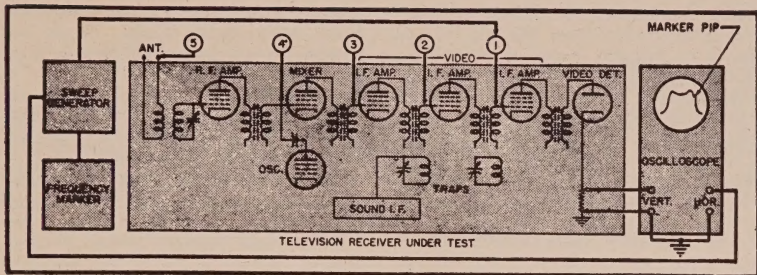


Fig. 5. Visual alignment of a typical television receiver.

ful here but not completely necessary as a few adjustments while observing the visual trace will indicate the effect of tuning. If errors are made in early adjustments, they may be compensated for later by an over-all "touch-up."

The usual procedure in i.f. alignment is to tune and check each stage starting from the output i.f. amplifier and working "backwards" toward the front end of the receiver. The important points to check on the resultant over-all curve are the video carrier, i.f. frequencies, sound i.f. frequency and any irregularities that may appear. The picture i.f. carrier frequency should correspond to the 50% response point on the high frequency side of the bandpass and the sound traps incorporated in the video amplifier should be tuned so that the trace shows a marked dip at the sound i.f. carrier frequency. The relation between the peaks and troughs within the bandpass should be such that the amplification is never less than about 70% of maximum. Excessive peak amplitudes are usually due to improper tuning, however, as mentioned previously, any tendency toward regeneration may cause excessive amplification at one particular frequency and introduce a very strong peak. Sometimes improper connection of the sweep generator output lead may cause regeneration or oscillation that ordinarily is not present and may lead to erroneous results. It is always desirable to connect the "hot" output lead directly to the circuit with as short a lead as pos-

sible and to connect the ground side of the output cable to a point close to the ground return of that stage.

After a trial alignment test has been carried out on the i.f. amplifier, it is well to check the over-all response curve as indicated on the scope thoroughly as to amplitude vs. frequency measurements. Always adjust the horizontal sweep width and the sweep generator output so that the visual trace is centered and covers a good portion of the screen. To measure frequencies along the trace, the frequency marker generator is put into use. The marker generator is tuned to desired points of measurement within the bandpass of the trace and set so that a small "pip" appears. This "pip" will travel along the curve as the marker generator frequency is changed. Sometimes a calibrated absorption type of wave trap coupled to the sweep oscillator of the sweep generator is used as a marker. This type of marker will produce a small notch in the visual curve at whatever frequency it is tuned to, provided that it is within the bandpass of the amplifier under test.

At certain points, particularly at video carrier frequency, sound frequency, etc., on the curve, amplifier gain measurements should be made. To do this the deflection sensitivity of the scope in volts/in. should be known, and a scale used directly on the cathode-ray tube face.

The gain of the amplifier will be proportional to the height of the curve provided, of course, that the amplifiers of the scope and/or receiver are not

being overloaded. Amplitude measurements are made from the top of the curve to bottom, however, it will be noticed that the axis or location of the curve in a vertical direction will change as the shape of the curve changes due to tuning adjustment. This is because the axis of the trace is actually an imaginary line extending through what might be considered the average amplitude of the vertical deflection voltage. For example, when a sinusoidal waveform is observed on the oscilloscope, its axis is considered to be a line right at the center of the curve. When the curve is not symmetrical, the curve may move up or down with respect to its axis, depending upon its shape. The effect as far as the visual alignment curve is concerned is that the curve will change its vertical position as its shape is changed but this effect should be considered apart from that due to the actual amplifier characteristic, and amplitude measurements made on the actual height of the curve regardless of position.

In Fig. 5, it is shown that the receiver output is always taken from the 2nd. detector load resistor and then applied to the scope deflection terminals. This is important since the fluctuating voltage which provides vertical deflection of the visual trace is actually a d.c. component varying in proportion to the gain of the amplifier and not the input r.f. voltage that is applied to the amplifier. It is interesting to note that if this connection were made directly to deflection plates of the scope without any intervening amplifiers, the d.c. level of the vertical signal voltage would remain constant and the axis of the trace would remain steady regardless of tuning adjustments. This is a desirable property in a visual alignment setup but not entirely necessary.

After the i.f. amplifier has been correctly adjusted, tuning of the circuits ahead of the r.f. and mixer stages is in order. The procedure is quite similar although perhaps not as exacting. Usually the front end circuits are designed to pass a band of about 5 or 6 mc. in width so that the picture and

sound carriers are situated within the front end response curve. Front end circuits should be tuned so that they do not materially change the shape of the over-all i.f. curve but merely increase the gain of the receiver as a whole.

Final Adjustment

After alignment has been completed the best check is to tune in on a local broadcaster, preferably when the standard test pattern is being transmitted. Observation of the standard test pattern will usually show up any effects of improper alignment, assuming of course that the other sections of the receiver are performing properly. If the set has been properly aligned a clear and stable pattern will result. Picture definition may be determined by observing the vertical "wedge" lines particularly where they converge and meet the "bulls-eye" in the center of the pattern. In high quality receivers it should be possible to resolve the individual lines until they almost meet the pattern center circle. This indicates that the receiver is capable of reproducing a video band of at least 4 mc. in width. The pattern should also be observed for its signal-to-noise ratio, and contrast. Poor contrast or "flat" pictures accompanied by "snow" (noise) may indicate poor sensitivity due to improper r.f. alignment or improper shaping of the i.f. curve. For example, if the receiver amplitude response is much less than 50% at the video carrier frequency, the effect will be the same as if reception is attempted on a very weak station. Receiver noise will become comparable with the signal and a weak video signal will be applied to the picture tube. On the other hand, situating the picture carrier too far "up" the selectivity curve will result in excessive contrast and poor picture definition.

Usually an improvement in picture quality may be made by a final adjustment on the receiver local oscillator. After the set has been aligned and placed into operation, and tuned to a test pattern of a local station, the fine tuning control should be tuned care-

(Continued on page 15)



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FOR SALE — Portable 3" Synchroscope complete with 11 tubes. Used, sacrifice, \$35. Lewis Mascara, 197 McKay Ave., Huntington Station, Long Island, N. Y.

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FOR SALE — One McMurdo Silver Vomag Model 900. Very good condition. Price, \$45. Norman D. Huey, 416 Lane, Topeka, Kans.

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FOR SALE — Standard brands of radio tubes, 50 to 60% off list price. Guaranteed. J. T. Cataldo, 222 St. Marks Ave., Brooklyn 17, N. Y.

SELL OR TRADE — Hamilton 22-jewel Army Air Force Pocket Watch. Sweep hand and stop watch features. Want 7X50 binoculars, or good Hallcrafters or Hammarlund receiver. Fred Simonian, 83 Shepard St., Lynn, Mass.

WANTED — Part-time work after 3 p.m. in radio repair shop. Am veteran attending N. Y. Technical Institute of New Jersey. Familiar with all types of test equipment and want experience in Radio-Television Repair line. Harold Sambursky, 1668 Vyse Ave., Bronx 60, N. Y.

SWAP — Movie Films. Tell us what you have in 16mm sound, silent, or 8mm complete subjects. Movie equipment of all types and supplies sold, repaired and exchanged. Lewy Radio & Movie Service, 853 N. Eutaw St., Baltimore 1, Md.

FOR SALE — National "One-Ten" receiver; Hallcrafters HT9 and S36A. 80 meter V.F.O.; signal tracer; car radio, Southwind gasoline heater; 3/4 H.P. Briggs & Stratton; 1/4 H.P. electric motor; set of furnace controls (electric); Hawaiian Guitar, all like new. Best offer. Charles W. Schecter, Scenic Drive, R. 2, Muskegon, Mich.

FOR SALE — Crowe Remote Dash Control Kits for 1940 and older cars. Price, \$1.50 C.O.D. G. Brennan, 1493 South Main St., Akron, Ohio.

TRADE — \$5 course of instructions for ornamental figure casting, modeling and mould making, for Ungar Soldering Pencil with extra tip, or what have you? John D. Grow, 7712 Westmoreland, Swissvale, Pa.

SELL OR SWAP — Three small 4 and 5 tube radios. Want C-R Bridge Midget 3-way Portable, or what have you? W. Landis, 8815 75th St., Woodhaven 21, N. Y.

FOR SALE — 25 CD also Aerovox and Sagamo heavy duty mica condensers, 1000 to 5000 V. test; 20 600 V. bathtub condensers; 2 Western Electric, 50 mmf., 5 KV., 5 Amp vacuum condensers; 1000 KC crystals for Navy LM frequency standard. Write Wm. Zechiel, 576 So. St., Glendale 2, Calif.

FOR SALE — Five General Industries Model D heavy duty 2-speed phonograph motors. \$10 each. Bower's Music, 716 South Pacific Ave., San Pedro, Calif.

SELL OR SWAP — 28 volt, 200 amp, GM Aircraft Generator, packed for shipment, and Willard 24 volt aircraft battery, steel cased, dry. Both for \$45. Want S-36, VHF-152, transmitting equipment. Guy Black, 12 Lambert Road, Belmont, Mass.

FOR SALE OR TRADE — CA-11 Signal tracer, single-button carbon "Handi-Mike," switch on chrome plated handle; Meissner "Signal Splicer" with plug-in coils. Make an offer. R. C. Hequet, 795 N. 10th, Kankakee, Ill.

FOR SALE — John Meck No. 20 Tube Checker with diagram, \$20; Dayrod series 20-22 tube checker, \$10; Sterling R403 reactivator, \$3; All in good condition. Various tubes in cartons at 60% off list. J. H. Ellis, P. O. Box 63, Vermillion, Ohio.

FOR SALE — Guitar Microphones. Work on new principle. Will play through any amplifier or phonograph outlet of any radio. Price, \$12.50. Will send descriptive circular on request. Berman Distributing Co., 1188 Broadway, Brooklyn 21, N. Y.

FOR SALE OR TRADE — 50 lessons of NRI Course of 1945 at \$15. New Crystal Mike, Model RC, \$6. 91F 262 Kc high gain coils, \$3. Need Utah VPT4 50 MA transformer with 300-0-300 V. secondary. Chester Wegrzynowski, 104 Beck St. Buffalo 12, N. Y.

TRADE — 1944 NRI Course, 65 lessons, All condition, including V.T.V.M. and AC Power Pack already wired from kits, Compo fluorescent lamp and starter tester, Supreme 542 in metal case. Want Hallcrafters SX25. OK Radio Service, Bells, Tenn.

TRADE — \$250 worth of NuProcess Silver Plating & Silver Cleaning products for radio test equipment. Will answer all letters. Wilson J. Merrit, R.F.D. 1, Pryor, Okla.

SELL OR SWAP — Western Electric 630-A or 633-A Dynamic Microphone. Need good portable radio or German Luger in good condition. Suburban Sound Service, 3625 Euclid Ave., Berwyn, Ill.

WANTED — Position as Engineer in Radiotelephone or Radiotelegraph. Have Radio Amateur licenses, broadcast experience, Radioman 1st Class in Navy 3 years. Oper. position preferred. L. E. Ryan, 731 W. So. Ave., Independence, Mo.

SELL OR TRADE — Transceiver less power pack. In working condition. Want portable typewriter or what have you? Also Rider Chanalyst, in good condition, \$135. All items F.O.B. Ellison Radio Service, Centertown, Ky.

SELL OR SWAP — Philco Audio Signal Generator, \$25. Jackson 562 Audio Oscillator, \$90. Sprague Tel-Ohmike, \$40. Solar C. E. Capacitor analyzer, \$40. R. C.P. tube & set tester 803 all tubes roll chart, \$60. Television, 11 Brooklyn Ave., Westbury, N. Y.

FOR SALE — Hickok 305 Oscilloscope, slightly used, \$110. Rider Manuals, I-V abridged, and VI-XIV like new, \$115. All F.O.B. Visalia, Calif. H. E. Stratton, Jr., 427 So. Garden, Visalia, Calif.

SWAP — 30W Amplifier, Bogen Velocity VR-HF, Shure Crystal 70H microphones, 70 generator condensers, Pal portable phonograph. Want Riders 11, 14, 15 professional tenor banjo, tenor guitar, regular guitar. Don't want cheap instruments. Brace Radio, 32-09 44 St., Long Island City 3, N. Y.

FOR SALE — Self-charging all wave GE portable radio, \$86.50; 6-tube G.E. portable ac-dc battery, \$45; G.E. automatic phonograph combination, \$76; 13 channel Television receiver with AM broadcast, \$499.25. Also GE, RCA, Sylvania tubes, any quantity, 50% off, industrial type tubes, 20 off. Want portable transcriber, Leica camera, P-38 or Luger. John Magnus, 9415 S. 55th Ave., Oak Lawn, Ill.

SELL OR SWAP — One set Baldwin type C headphones in excellent condition. Three 35 mmfd. Hammarland MC condensers, also three of same 140 mmfd. E. S. Barnett, Republican Grove, Va.

FOR SALE — 600 watt transmitter, four stages, 810 final, seven meters, five decks, nicely built into a steel 6 foot rack and panel job. Price, \$145. R. A. Sanders, 1541 South Trumbull St., Chicago 23, Ill.

SWAP — Large Stromberg Carlson chassis and speaker in working order; Philco chassis, no speaker; six small radios, some play. All without tubes. Exchange for portable tube checker, such as a Triplett Model 2425, in good working order with instructions. M. Viden, 1044 Morris Ave., Box 56, New York, N. Y.

FOR SALE — Complete radio and television repair stock and equipment. 5 complete Ham rigs; 3 complete television (7'') sets; 2 kits of parts almost complete for 10" sets; 1 unfinished cabinet; heavy duty battery charger and 12V battery. Vincent Hillman, 689 River Drive, East Paterson, N. J.

FOR SALE — Audak Microdyne PRO-2 pickup in A-1 condition; General Industries model RX phonograph motor and turntable. Triplett model 1232 A signal generator, like new. Make offer. Maynard R. Brackney, 1050 Ardmore St., S. E., Grand Rapids 7, Mich.

FOR SALE — Tubes, all types, very cheap. Send for list. Also radio parts. Have approved model A-200 signal generator, like new, \$26. L. Strollo, 147 Linden St., Brooklyn 21, N. Y.

WANTED — Field strength meter 50 to 150 MC, television sweep generator, Boonton models 160 A & 170 Q meters, General Radio 650A impedance bridge, Elliot Cardverter, Mico engraving machine. Electronic Instrument Lab., 56 Spooner St., Floral Park, L. I., N. Y.

FOR SALE — 4 in. bakelite vernier dial, 12:1 ratio, \$.50; 250 and 365 mmfd. tuning condensers, .25 each; basic Zenith 6-tube super, \$2; soldering iron; type 30 tubes. Bill Benner, 145 So. Maple, Webster Groves 19, Mo.

FOR SALE — C.H.T. multiple tap output transformer T-15S92; C.H.T. input transformer T-15D85; Thordarson Choke T-75C51. All like new. Want Cinacudagraph, HW 13-13 speaker. C. E. Breth, 213 So. 4th. St., Youngwood, Pa.

SALE OR SWAP — Winchester model 52 rifle, like new, with 4 power scope and 500 rounds of Remington Kleanbore long rifle shells. Want latest model Wilcox Gay Recordio. Cook Radio Service, 530 So. 21st St., Lincoln 8, Nebr.

FOR SALE — 3 tube ac-dc phono amplifier, volume & tone control, \$2.85; Astatic crystal pickup, \$1.95; Alliance phono motor, \$3.25; Maguire automatic record changer, \$13.95; V.M. automatic mixer-changer, \$17.95. Raytone Electronic Company, 25 B Frankfort St., New York 7, N. Y.

FOR SALE — Hewlett Packard Model 300A Harmonic Wave Analyser. Wm. D. Crosby, The Superior Electric Co., Bristol, Conn.

FOR SALE — 10 watt amplifier complete with two 8" dynamic speakers and table mike. Has phono-mike input. \$40. I want to buy a 25B8 tube. P. A. Weaver, 19 Front St., Catsaqua, Pa.

FOR SALE — Complete 35 watt P. A. system, \$100. Also V.T.V.M., ac-dc volts 3000 ohms to 2 billion, 7" square meter. \$40. Both are F.O.B. Marvin Radio, 14 E. 208 St., Bronx 67, N. Y.

WANTED — A 25B5 tube. Send price. Also plans for phono oscillators, using all types of tubes. R. W. Johnson, 6505 Ridgewood Ave., Chevy Chase 15, Md.

SELL OR TRADE — Ferret 600 Signal Generator, like new. Will sell for \$35 or trade for a signal tracer. Salida Music Store, Box 325, Salida, Colo.

SALE OR TRADE — One R.C.P. multi-meter model 413, one model 461; one R.C.P. tube & set tester, model 801; one R.C.P. model 803 tube & set tester, built in tube chart; 2 Westinghouse Rectigon battery chargers; signal tracer. All in A-1 condition. Boyd Branch, 1732 1st St., N. W., Washington, D. C.

WANTED — Power transformer unit for Silvertone model HS-32939; power transformer for Columbia Kolster Phono Amplifier model 900-901 (complete power unit will do); power pack for Radiola 18. C. E. Bower, 600 S. Interbay Blvd., Tampa 6, Fla.

SALE OR SWAP — Agfa 35mm candid camera; 9mm automatic with shoulder holster; Webster and other changers; all kinds of radio parts. Want signal generator and or portable typewriter. O. W. Perry, 14 S. Warren St., Dover, N. J.

FOR SALE — Five guaranteed Signal Corps xtals—3510, 3520, 3550, 3580 and 3945 KC. Also 35Y4, 14B6, 50A5 and 14K7 tubes in original cartons. David Louie, 2160 E. 78 St., Cleveland 3, Ohio.

SELL OR SWAP — Ihagee 2 1/4 x 3 1/4 camera (German). Takes plates, cut film, or film pack. Perfect condition. Want G.E. 2 volt 5 band portable, good F.M. set, or what have you. A. S. Rosenzweig, 90-23 149 St., Jamaica 2, N. Y.

SALE OR TRADE — Precision Sines 856P Dual-Sensitivity multi-range tester. Will swap for good used typewriter or adding machine, or will sell for best offer. Turner's Radio Sales & Service, Box 393, Wetumpka, Ala.

WANTED — A power transformer for RCA RE-32 or RE45 as used in type 245 amplifier unit. Please state price. Ammon Radio, 27 Grand St., Hartford, Conn.

FOR SALE — Precision E-200 signal generator, in original carton and like new. Price, \$54. Milton Maultasch, 535 Grand St., Brooklyn 11, N. Y.

WANTED — Position in Oregon town. Experienced service man. All letters answered; will give qualifications in first letter. R. B. Wearne, Bloomfield, Nebr.

WANTED — One Code Oscillator for phones or with speaker. Have photographic parts or cash. Haven Whanger, 519 Logan St., Steubenville, Ohio.

FOR SALE — Range Calibrator model 1-178 in original packing case, two instruction manuals. 18 tubes, miscellaneous spare parts, cables, metal carrying case. Price, \$15. Radio Communication Service, 4475 Myrtle St., San Diego 5, Calif.

FOR SALE — HQ-120X. Best offer. Other ham equipment also. Ximrs, chokes, etc. All inquiries answered. W2AYL, 208 Allwood Rd., Clifton, N. J.

FOR SALE — RCA 155C 3 inch oscilloscope in new condition, \$75. All inquiries answered. C. P. Rataski, 393 E. Cliveden St., Philadelphia 19, Pa.

SELLING OUT — All merchandise—parts, tubes, etc., at fifty per cent off list. Send for list. Will ship COD. Allwood Radio Shop, 208 Allwood Rd., Clifton, N. J.

FOR SALE — Complete Sprayberry Course in Radio Theory and Fundamentals, \$35. Following issues of Radio News: July, November, December, 1945; March, May, 1946. \$25 each or 5 for \$1. Write Gerald Spector, 158 Chestnut St., Lakewood, N. J.

FOR SALE — 2-50 Tube in perfect condition. Philco battery set with the following tubes: 1E7, 1H4, 1D7, 1D5, practically new. All for \$8. Michael Furia, Box 65, Clarendon, N. J.

FOR SALE — Presto "K-8" Professional Recording Machine, Shure "55C" mike, mike stand, Presto cutting needle. Only two months old. Price, \$312. Petricca Radio, 110 Hancock St., Everett 49, Mass.

FOR SALE — Superior model 670 volt ohm meter like new, \$25. Also some hard to get tubes. All replies answered. Cranston Radio Service, 2112 Brown St., Flint 3, Mich.

WANTED — HRO receiver and Meissner signal shifter. Parts for sale; send for list. Alfred Freitag, 1437 Patapsco St., Baltimore, Md.

FOR SALE — Rider's 1, Gernsback's 2, both, \$3.50. Rider's III, IV, V, VI, \$7 each; all, \$24. VII, VIII, \$10 each; both, \$16. All in excellent condition and complete. All prepaid, \$43. R. J. Clark, Bellmore, N. Y.

FOR SALE — Used Army oscilloscope, \$50. Parts worth much more than this. James Glassel, St. Croix Falls, Wis.

SALE OR TRADE — Have N.R.I. Radio and Television Course complete for sale. Trade for test instruments or what have you. Stevens Radio & Electric Service, 346 Dewitt St., Buffalo 13, N. Y.

SELL OR SWAP — 1 Bolex model H-8 8mm camera with 3 lenses; 1 Bell & Howell 8mm projector, model 122A, all in perfect condition. Want 16mm sound projector. Harry McLeod, 705 N. Richmond St., Appleton, Wis.

FOR SALE — QST magazines, 1934 to 1946, \$3 per year; Mark II tanks set, extra mike and headphones; Shure crystal mike model 70H; Waterbury ship's clock, ship's bells. Will trade for Halli-crafter Sky rider marine model S-22R. A. Brizzolari, 146-13 58th Road, Flushing, N. Y.

FOR SALE — Triplett Tube Tester, model 1213. Good condition. Price, \$20. Leon J. Kamienski, 1343 N. Rockwell St., Chicago 22, Ill.

FOR SALE — Completely equipped radio shop, tools, instruments, technical library, large stock of tubes, etc. For details write to Radio Service Co., 17th St. Extended, R.F.D. 1, Box 13, Virginia Beach, Va.

FOR SALE — Collection of Radio Craft Magazines from 1936 to August, 1947, and 23 Radio News. Make offer. Also have two complete sets of plug-in coils, long & short wave, for \$5; one Superior Tube Tester and Analyzer, model 1180-S, for \$18.50; one Superior Generator model 1130-S, for \$18.50; 5 Power Transformer, 6 to 8 tubes, all for \$8. A. Lago, 92 Andrew St., Bayonne, N. J.

WANTED — Used receivers with standard and shortwave; fans with two or more poles; German-English Glossary TM30-490. Have books on Mathematics, Electricity, H.F. heating, Servo F.M., Automatic Control, etc. H. Hsu, 20 Divinity Hall, Divinity Ave., Cambridge 38, Mass.

FOR SALE — Radio News, Radio Craft, QST, and other radio books of any year. Also Radio & Television Today from 1937 to 1941. All books in fair condition. All letters answered. S. Tommy Wrublewski, 15-17 West 65th St., New York 23, N. Y.

WANTED — To contract Sub-Assembly Radio Wiring and complete small radio assembly and alignment. Am equipped to take care of your demands. Please state your requirements. Francis W. Clabaugh, Fountain City R.R., Bethel, Ind.

SALE AND WANTED — 2-Station Intercom System without tubes, \$10. I want the following tubes, 1SB6 and 1SA6. K. H. Logan, 13 Water St., Northfield, Vt.

FOR SALE — Complete set of Riders Manuals at 50% of cost. Contact Francis Typewriter & Radio Co., 141 West 10 St., New York 14, N. Y.

FOR SALE — Vomax V.T.V.M.; meter is damage proof. With instruction booklet, \$49. Frank Cotugno, 40 10 108 St., Corona, N. Y.

FOR SALE — BC-348-O. Completely converted with heavy duty power supply and matching speaker, all in perfect condition. Price, \$60. Alan W. Umland, Box 25, Waller, Texas.

FOR SALE — 1 BC 191 Transmitter complete with tubes, 1 tuning unit, and instruction manual, but less dynamotor, for \$17.50. All letters answered. Brentwood Radio Service Shop, R.F.D., Exeter, N. H.

WANTED — Variable Condenser, 4' gang 365 MMFD, with trimmers, up to 6 1/2 inches in length. State dimensions. J. F. Tremiere, 42 Cherokee Avenue, Allendale, N. J.

TRADE — Have Weston Analyzer model 660, also Weston Analyzer model 665; Triplett volt-ohmmeter model 666. Want portable tube tester, preferably Weston model 777. M. H. Davidson, 1104 W. Slauson Ave., Los Angeles 44, Calif.

WANTED — Dial Face, part No. 36435, Grunow Radio model 1191, Chassis 11G. A. M. Corey, 39 Donald Place, Staten Island 10, New York City.

SELL OR SWAP — Univex Corsair I 35mm camera with built in exposure meter. Best offer, or will swap for radio equipment, parts, etc. Martin Herbstman, 1806 Sterling Place, Brooklyn, New York.

FOR SALE — Army Radio Manuals. Write for numbers available. \$2.50 each. Various German Radio Tubes, guaranteed. Write for numbers available. German 2 1/2" O-250 volt ac-dc meters, \$2.50 each. Two 110 volt ac, dry disk rectified 8" speakers, \$6 each. Albert C. Hart, 4848 Linden Ave., Hammond, Ind.

SALE OR SWAP — One DZ-2 Radio Direction Finder. Complete with loop and dynamotor. Will swap for test equipment. Am especially interested in signal generator, late model, or what have you. John P. Weeks, 762 Patterson, Memphis 11, Tenn.

FOR SALE — Television Receivers, 7", assembled from kits. Like new and guaranteed. Price, \$195. Reisman Television Laboratories, 319 Canal St., New York 13, N. Y.

WANTED — QST, Dec. 1946, which has BC-375-E data in it, and would like complete diagram of same. Robert Sleyster, 203 S. Walker Ave., Blair, Nebr.

SALE OR SWAP — 1946 NRI Radio Course complete with all kit parts, less soldering iron, prepaid. Best offer, or trade for 12-15 watt amplifying system. Frederick Schamu, 200 3rd St., Liverpool, N. Y.

WANTED — Hallicrafter CN3 or CN5 FM Converter in good shape. F. W. Jones, Gabbs, Nev.

FOR SALE — Hickok & Triumph 3" Oscillographs, \$60 each. Bliley Crystal Controlled Oscillator, \$40. Solar CE Capacitor Analyzer, \$40. Aerovox 95 LC Checker, \$20. All instruments are in good condition. R. Chang, 421 East Lewis, Fort Wayne, Ind.

FOR SALE — Communication Receiver RME-69, 550 Kc to 31 Mc, AVC, BFO, 8" PM speaker in matching cabinet. Excellent condition. Best offer. Philip J. Freed, 100 Kingsland Road, Clifton, N. J.

FOR SALE — Precision E-200 Signal Generator in new condition. Complete with instructions. Price, \$52.50, Express prepaid. Joseph F. Brown, 34-05 28th Ave., L. I. City 3, N. Y.

FOR SALE — Complete radio repair shop with all test equipment, repair parts, including a good stock of radio tubes, all manuals, and good work bench. John A. King, King's Radio Service, Route 3, Box 77, Kinston, N. C.

FOR SALE — The following books in excellent condition: Radio Engineer's Handbook; Radio Engineering; Frequency Modulation; Measurements in Radio Engineering; Mathematics for Radiomen & Electricians; UHF Techniques; Hyper and UHF Engineering. The lot, \$30, postpaid. E. W. Hoffman, 325 28th St., S. E., Grand Rapids 8, Mich.

WANTED — Light Outboard Motor. Have two 6" almost new electrodynamic speakers, two old folding Kodaks, one Hartley circuit code practice set complete, one pair Northland skis in good condition with bindings and poles. Also other things or cash. Witte S. S. Schlissel, Box 10, Kingsbridge Station, New York 63, N. Y.

FOR SALE — Automatic Record Player. Attractive case, Webster Chicago changer, and 4-tube amplifier. Price, \$65. S. Jack Pirkle, 130 S. Jackson St., Oakland City, Indiana.

VISUAL ALIGNMENT

(Continued from page 8)

fully for optimum picture quality. As stated before, this condition will be obtained when the picture carrier is situated around the "50% point" of the receiver response curve. The actual best location for the video carrier may vary somewhat and is therefore best determined by tuning the local oscillator until the pattern appears at its best. After this operation is carried out, it may be found that the accompanying sound is slightly off tune. This is remedied by retuning the discriminator and sound i.f. circuits. It will be found that as experience is gained in i.f. front end alignment and adjustment of the local oscillator made more accurately, final "touch-up" adjustments will rarely be necessary.



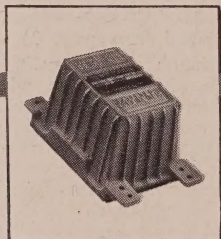
a **Plug** from our good friend, the C-D serviceman...

JOHN NEARY of Somerville, Massachusetts
chews the fat with us by mail

says John: "... thank you for your splendid little helper 'The Capacitor'. I have obtained much useful information from it ..."

"I have two Mica Transmitting Condensers made by you and dated February 26, 1917—capacity .004 MFD. working voltage 12,500. I have operated these condensers recently at 7,500 volts and they still take it."

say we: Thanks for telling us, John. Thousands of our other C-D friends, too, have been writing us about similar experiences, all through the years, with our almost indestructible C-D capacitors.



← This is Neary's C-D capacitor manufactured in 1917

it's easy to see —
experts prefer C-D

CORNELL-DUBILIER
WORLD'S LARGEST MANUFACTURER OF
CAPACITORS



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For your nearest authorized C-D distributor consult your local Classified Telephone Directory